NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

AIR TRANSPORT ECONOMICS.

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October, 1922.

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The cost of service on the commercial air lines at present operating in Europe does not always bear a direct relation to the costs of operation. It must be admitted that the charges for air transport at present are much lower than they could possibly be set if the business were to stand on its own feet without subsidy. The time will come when subsidies will be withdrawn, and when that time arrives it will be very important to have some actual knowledge of the cost of operation per passenger-mile or per ton-mile for express.

It is surprisingly difficult to secure reliable information on costs of operation. The companies either have no accurate figures or conceal them as a trade secret, but there is one source, fortunately, from which unimpeachable information can be drawn. One of the greatest uses of the United States air mail has been to serve as a laboratory of air transport, as an experimental enterprise which, carried on over a long period and on a reasonably large scale, would show the real possibilities of commercial flying and the conditions under which it could be most advantageously carried on.

Taking the air mail figures as a basis, then, it has been found that the total operating expenses, including all overhead, are about 80 cents per airplane-mile. This would work out at a discouragingly large figure per ton-mile, but the airplane-mile

* Taken from Christian Science Monitor, September 18, 1922.

really furnishes a better unit of comparison in this case, as the airplanes used are of a military type and do not afford the cargo capacity which should be obtained with the engine power used. The engine is a 400-horsepower Liberty. It has repeatedly been shown to be possible to design commercial airplanes which carry a pay load of passengers, mail, and express of five pounds per horsepower, or roughly, one passenger with the normal amount of baggage for every 40 horsepower. Working on this basis, the Liberty should carry a pay load of a ton, whereas the restricted space available in the mailplanes actually makes it impossible to carry more than 850 pounds.

If it be assumed, however, that a true commercial airplane could be built to operate at the same cost per mile as the mail plane and to carry the pay load just mentioned, the cost would be 80 cents per ton-mile, or, allowing 200 pounds for each passenger together with the luggage which he is allowed to carry, 8 cents per passenger-mile. This, however, includes no profit to the stockholders and no allowance for the expense of selling and advertising, which more than counterbalances the saving on post office overhead expense. It may, therefore, be taken only as an approximation to the minimum possible cost and a more detailed survey leads to the conclusion that air transport with present-day airplanes and without subsidy can be made profitable under American conditions at a minimum rate of about 15 cents per passenger-mile. This is only 15 per cent higher than the rate of the subsidized London-Paris line.

The major items of expense are the wages of pilots and mechanics, repairs and upkeep on flying equipment, depreciation, insurance, fuel and oil, and ground organization expenses. On the first two elements there must be no economy. Safe and regular operation can only be secured with the best pilots and mechanics that can be obtained , and they must be well paid. With a 10-passenger airplane of the type just suggested, wages account for roughly 3 cents a passenger-mile if the airplanes are kept in continuous operation and carry 70 per cent of a full load on each trip. Repairs and upkeep vary widely with the type of airplane employed, but they may be taken as 6 cents per passenger-mile, including depreciation. This estimate is based on a life of 2000 miles for an airplane and 1000 for an engine, which is as much as can be expected at present. Fuel and oil are a relatively small item, amounting to only about 2½ cents for each passenger and each mile. Insurance costs amount to approximately 1½ cents per passenger-mile, although rates vary so much that it is hard to give a definite figure. These four items total 13 cents, and a 15-cent rate will evidently show a profit only if the load factor or commercial efficiency, can be raised above the 70 per cent assumed.

Finally, as to ground expense, no single figure can be given Everything depends on the share of this load which the Government undertakes to carry. The provision and equipment of air routes and flying fields certainly is as logically a governmental enterprise as is the maintenance of harbor facilities and lighthouses

and it is absurd to expect a single company to maintain its own flying fields. If any such burden is thrown on the operators of commercial aircraft, the minimum costs per passenger-mile will be not 15 cents, but 20 or 25 cents. In the failure of the United States Congress to take effective steps to make possible the ground organization of air routes lies one of the greatest obstacles with which commercial flying in this country has to contend.